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Simulations of Rayleigh-Taylor Growth for Direct Drive and with Material Strength[1]

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We have carried out simulations of Rayleigh-Taylor perturbation growth in a variety of environments of interest to the inertial fusion progam. Growth of ablation front modulations under direct drive laser illumination is one important example.[2] We have considered both acceleration of planar foils, where we can compare results with experiments, and implosions of capsules designed to achieve ignition on the National Ignition Facility. Modulations may originate as surface perturbations or may be imprinted upon the target from intensity modulations in the laser. Ignition capsule designs are predicted to have large growth factors for spherical harmonic modes greater than l=50, which carries ablation front modulations far into the nonlinear regime. Simulations examine nonlinear saturation in the presence of ablation. Saturation is in reasonable agreement with predictions of the Haan[3] model.

We have also simulated Rayleigh-Taylor growth at embedded interfaces in planar packages accelerated by indirect drive. At high drive pressures this is more nearly the classical case, as compared to an ablation front, although compressibility effects still occur.[4] At lower pressures and with the use of pulse-shaping, we believe that we can access a regime where metals remain solid and retain strength, even for compression to 1.5 times normal density. Material strength can reduce, suppress, or delay Rayleigh-Taylor growth compared to the inviscid fluid case. We compare simulation results with recent experiments[5] and with theoretical predictions.[6,7]

1. Work performed under the auspices of the U. S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.
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